Lake of the Woods Vegetation Management Plan Update

Marshall County, Indiana

2006

http://129.79.145.7/arcims/statewide_mxd/viewer.htm

Prepared for:

The Lake of the Woods Property Owners Association

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Executive Summary

Two aquatic vegetation surveys were conducted on Lake of the Woods in 2006. The first survey was conducted on May 18, 2006 and the second was conducted on July 27, 2006. The purpose of these surveys was to document any changes in the plant community from the 2005 survey, and to monitor the lake for any re-growth of Eurasian watermilfoil, as well as re-establishment of native species.

No chemical treatments were conducted on the main lake during the 2006 season. This was done to enable beneficial, native plant species to colonize areas where Eurasian watermilfoil had previously occurred. Funds were set aside in case spot treatments were necessary to eliminate areas of watermilfoil re-growth, but it did not return to the lake in summer of 2006.

The May 18, 2005 survey found that sago pondweed, a native plant, was re-establishing itself in many areas of the lake where Eurasian watermilfoil had been dominant prior to the whole lake Sonar treatment. Most of the sago pondweed was growing in 2-5 feet of water. A small amount of Richardson's pondweed was found along the southeast shoreline, which is also a native plant. Curly leaf pondweed, an invasive plant species was observed in moderate abundance in the extreme north end of the lake during the spring survey.

In late September of 2006 small areas of plant growth were observed in the north end of the lake. These small beds are believed to be Eurasian watermilfoil and it is expected that the invasive plant will return to Lake of the Woods is somewhat greater abundance in 2007. Although it is not known how many acres may be affected by Eurasian watermilfoil re-growth, funding should be set aside to provide maintenance of the invasive plant. Areas of Eurasian watermilfoil re-growth will be treated with Renovate Herbicide (active ingredient: triclopyr).

2007 Cost Estimates

1. Chemically treat areas of Eurasian Watermilfoil Re-growth

*All cost figures are estimates only. All prices are subject to change pending 2007 chemical pricing.

A. Treat 20 acres of Eurasian milfoil with Renovate $ 9,500

2. Conduct 2 aquatic vegetation surveys (spring and fall) to monitor both Eurasian milfoil and native plant populations.

A. Spring and Fall Tier II Vegetation Surveys and Plan Update $ 4,000

Acknowledgements

Aquatic vegetation surveys conducted on Lake of the Woods were made possible by funding from the Lake of the Woods Property Owner's Association and the Indiana Department of Natural Resources through the Lake and River Enhancement Program. Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for both Tier I and Tier II aquatic vegetation surveys. Gwen White, aquatic biologist for the IDNR Division of Fish and Wildlife provided valuable consultation regarding the requirements and objectives of this lake management plan. Brad Fink, and Jason Doll provided assistance and training for data analysis computer programs. Bob Robertson, District 1 Fisheries Biologist and Jeremy Price, District 1 Assistant Fisheries biologist also provided valuable input for this Project, and provided DNR survey data. Aquatic Weed Control would also like to thank the members of the Lake of the Woods Property Owner's Association for their commitment to improving this lake and for valuable discussion and input brought forward at the informational meeting held on November 4, 2006.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

Lake of the Woods has been involved in the Lake and River Enhancement Program (LARE) since 2004, when the first LARE funded aquatic vegetation survey took place on August 25, 2004. Based on the results of this survey, a whole lake Sonar treatment was conducted in the following spring on May 5, 2005. The treatment was successful, and Eurasian milfoil was not found in the fall survey that year or in either of the surveys in 2006. The following chart summarizes all LARE funded activities on Lake of the Woods.

Table 1: Lake of the Woods LARE History

Year	Action	Date	Funding Source
2004	Fall Aquatic Vegetation Survey. Lake Management Plan	Fall Survey August 25, 2004	Lake and River Enhancement LOTW Property Owner's Association
2005	Spring and Fall Aquatic Vegetation Surveys as well as whole Lake Sonar Treatment Management Plan Update	Spring Survey April 28, 2005 Sonar Application May 5, 2005 Fall Survey July 29, 2005	Lake and River Enhancement LOTW Property Owner's Association
2006	No chemical treatments necessary as EWM did not return Management Plan Update	Spring Survey May 18, 2006 Fall Survey July 27, 2006	Lake and River Enhancement LOTW Property Owner's Association

2.0 Watershed and Lake Characteristics Update

(See 2004 Lake Management Plan)

Secchi disk readings remain very low at Lake of the Woods. Planktonic Algae blooms are still common throughout the later part of the summer, further reducing water clarity. The absence of submersed aquatic vegetation (SAV) makes the lake more susceptible to these types of blooms. Water levels remain low throughout much of the year.

3.0 Lake Uses Update

(See 2004 Lake Management Plan)
Recreational use of Lake of the Woods was improved for boaters and skiers during 2005 and 2006. Dense beds of Eurasian watermilfoil that had previously interfered with these activities were no longer a problem. Weed lines composed of Eurasian Watermilfoil that were once used by fishermen were also removed. According to discussions with District 1 Fisheries Biologist Bob Robertson, fisheries surveys found that walleyes, one of the main sportfish in the lake, were relating to the sago pondweed beds which are increasing in Lake of the Woods.

4.0 Fisheries Update

The following fisheries survey and report was conducted by District 1 Fisheries biologist Bob Robertson and describes the Lake of the Woods walleye population in detail. This survey was conducted after the original lake management plan was written

Lake of the Woods

Marshall County

Supplemental Walleye Evaluation

Date of Survey: September 21, 2005

Biologist: Bob Robertson, FB

Survey Objectives: Evaluate the stocking success of walleye stocked at Lake of the Woods under workplan 204137 (Table 1).

Methods: Fish collection effort consisted of 1 h of pulsed D.C. night electrofishing with two dippers. Four stations (15 min. each) were sampled. Stations sampled and sampling effort were based on previous evaluations. Total length of each captured walleye was determined to the nearest 0.1 in. Scales were collected for age and growth determination.

Summary: We collected 78 walleye in the September 2005 sample ranging in length from 6.9 to 19.3 in. Fifty-three fish were age-0 fish ranging in length from 6.9 to 8.5 inches. Age-0 fish were collected at the rate of 53.0 fish per hour (FPH) in the 2005 sample. We also collected twelve age-1 fish (10.3 – 12.9 in), ten age-2 fish (13.0 to 15.4 in), three age-3 fish (15.6 to 17.0 in), and one age-4 fish (19.3 in) in the one-hour 2005 sample (Table 2).

Average length of fish aged from the 2005 sample is larger than noted from the 2003 and 2004 samples (Table 3). Mean length of age-0 fish at the time of capture has also improved over the last three years (Table 4). Growth of fish aged in the 2005 sample was considered average for northwest Indiana.

Comparing ten fall walleye evaluations conducted since supplemental stocking of walleye began in 1990, only the 1992 sample failed to collect more than the seven age-0 FPH required to consider that year's stocking successful (Shipman 1991). The poor results of the 1992 sampling is believed to be a result of stocking fry. Since walleye stocking began in 1990, age-0 walleye have been collected at an average rate of 34.8 FPH in the ten fall evaluations conducted during the 15 years of the program. The fall

2005 sample recorded the highest combined catch per hour (78.0 FPH). Survival of fingerling walleye at Lake of the Woods remains excellent.

We recommend that walleye stocking continue at the rate of 100 two-inch fingerlings per acre (41,600 fish). Additional fall evaluations should be conducted at three-year intervals. An additional creel should be conducted when budgets permit. The 2001 creel indicated a harvest of 358 walleye and 1,703 additional walleye caught and released. Harvest in 2001 was estimated at 1.03 pounds of walleye per acre with more than one-third of fishermen (35%) reporting that they were fishing primarily for walleye.

Literature cited:

Shipman, S.T. 1991. Determination of walleye year class strength utilizing standardized fall electrofishing techniques. Indiana Department of Natural Resources. Indianapolis, Indiana. 29 pp.

Brindza, N. 2002. Lake of the Woods: Creel survey 2001. Indiana Department of Natural Resources. Indianapolis, Indiana. 9 pp.

Submitted by: Bob Robertson, Fisheries Biologist

Date: 1/30/2006

Approved by: Stu Shipman, Fisheries Supervisor

Date: 2/13/2006

Table 2: IDNR Walleye Stocking

Table 1. Walleye stocking at Lake of the Woods, 1990 - 2005		
Year	# Stocked	Mean length (in)
1990	78,902	1.6
1991	-	-
1992	5,388,025	Fry
1993	27,500	1.8
1994	26,769	1.6
1995	27,720	1.8
1996	27,155	1.4
1997	27,328	1.6
1998	27,294	1.5
1999	27,300	1.8
2000	41,604	1.8
2001	42,284	1.6
2002	41,600	1.5
2003	41,600	2
2004	43,863	1.6
2005	39,831	1.6

Table 3: IDNR Lake of the Woods Walleye Lengths

Table 2. Length of walleye sampled at Lake of the Woods, 2003 - 2005.			
Length	2003	2004	2005
5.0	8		
5.5	9		
6.0	12	4	
6.5	17	4	
7.0	15	9	12
7.5	1	6	19
8.0		9	18
8.5		2	4
9.0		1	
9.5		1	
10.0	1	2	
10.5	1	2	2
11.0	2	6	5
11.5		2	5
12.0		1	
12.5	2	1	
13.0	1		2
13.5		2	2
14.0	1	2	1
14.5	1	2	2
15.0	1	1	1
15.5		2	2
16.0		1	1
16.5		1	
17.0			1
17.5			
18.0		1	
18.5		1	
19.0			
19.5			1
20.0			
20.5		1	
21.0			
Total	72	64	78

Table 4: IDNR Lake of the Woods Walleye Length

Table 3. Growth of walleye at Lake of the Woods, 2003 – 2005.											
Lake of the Woods			2003								
Walleye		Year	Number	Back Calculated Length(inches)at Each Age							
		Class	Aged	I	II	III	IV	V	VI	VII	VIII
Intercept =	2.2	2002	5	6.3							
		2001	4	6.3	11.1						
		Average Length		6.3	11.1						
		Standard Deviation		0.0							
		Yr. Classes Averaged		2	1						
Lake of the Woods			2004								
Walleye		Year	Number	Back Calculated Length(inches)at Each Age							
		Class	Aged	I	II	III	IV	V	VI	VII	VIII
Intercept =	2.2	2003	16	6.7							
		2002	5	7.3	11.6						
		2001	8	6.6	10.2	14.0					
		2000	2	7.6	12.2	16.6	19.5				
		Average Length		6.9	10.9	14.0					
		Standard Deviation		0.4	1.0						
		Yr. Classes Averaged		3	2	1					
Lake of the Woods			2005								
Walleye		Year	Number	Back Calculated Length(inches)at Each Age							
		Class	Aged	I	II	III	IV	V	VI	VII	VIII
Intercept =	2.2	2004	11	7.2							
		2003	8	7.2	11.1						
		2002	3	6.9	12.1	15.0					
		2001	1	7.8	13.1	14.9	18.1				
		Average Length		7.1	11.6	15.0					
		Standard Deviation		0.2	0.7						
		Yr. Classes Averaged		3	2	1					

Table 5: IDNR CPE and Mean Length of Age 0 Walleyes

Table 4. Effort, age 0 CPE, and mean length at capture of age-0 walleye from Lake of the Woods walleye evaluations, 2003 - 2005			
Date	Effort (min)	Age 0 CPE	Mean Length at capture (Age 0)
9/17/2003	60	62	6.3
9/28/2004	60	34	7.2
9/21/2005	60	53	7.7

Table 6: IDNR Comparison of "Catch Per Unit Effort."

Table 5. Comparison of effort and catch per unit effort of age classes of walleye in 10 samples at Lake of the Woods, 1990 - 2005.						
Year	Effort (h)	Age 0	Age 1	Age 2	Age 3+	Overall
1990	2	18.5	-	-	-	18.5
1992	4	0.3	-	3.5	-	3.8
1993	4	44.3	-	-	0.5	44.8
1994	2	35.0	12.5	1.0	-	57.5
1996	3	9.3	20.3	0.7	0.3	30.7
1997	2	37.5	11.0	1.0	-	49.5
2000	2	54.0	4.0	9.0	4.5	71.5
2003	1	62.0	6.0	4.0	-	72.0
2004	1	34.0	16.0	5.0	9.0	64.0
2005	1	53.0	13.0	8.0	4.0	78.0

5.0 Problem Statement

Eurasian Watermilfoil no longer dominates the Lake of the Woods plant community. The challenge in 2007 will be to prevent re-infestation of Eurasian watermilfoil by identifying areas of re-growth and treating them effectively with Renovate herbicide.

6.0 Management Goals and Objectives

The management goals outlined by the IDNR Division of Fish and Wildlife have not changed. They are restated below:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.

2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.

3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

The major objective of this project has changed from a large scale treatment effort to reduce the dominant milfoil population, to smaller scale treatments in areas where re-growth is observed in 2007.

7.0 Plant Management History Update

The major changes to the plant management history have been the whole lake Sonar treatment conducted on May 5, 2005, and the absence of chemical treatments for native species on the main lake, as native plant populations establish themselves.

8.0 Aquatic Plant Community Characterization Update

Two major changes have been adopted in LARE protocol that change the process of characterizing the plant community of Indiana lakes.

The first change is the switch from 2 Tier II surveys each year to just one Tier II survey per year. Prior to 2006, both a Tier I and a Tier II survey were required in both spring and fall. This year's protocol changed to require a Tier I survey each spring, and A Tier II survey if the fall, accompanied by a Tier I fall survey to document any changes in the to plant community from spring to fall.

The second change is in the formation of a new Tier II protocol. These changes are outlined in the methods section (8.1).

8.1 Methods Update

The Tier II survey protocol was changed by the IDNR in 2006. New LARE Tier II protocol requires that sample sites be stratified by depth contour. Prior to 2006 sites were to be spaced evenly through the littoral zone.

Before 2006, the number of sample sites required each lake were determined strictly by lake size. In the 2006 protocol, the number of sample sites needed is based on both lake size and trophic state. Trophic state describes the productivity of a lake and is correlated with plant growth, secchi disk, and nutrient availability. There are 4 different trophic states listed by the IDNR: Oligotrophic, Mesotrophic, Eutrophic, and Hypereutrophic. Oligotrophic Lakes usually have clear water and few nutrients, while Hypereutrophic lakes usually have deeply stained water and are nutrient rich. Table 7 is taken from the IDNR 2006 Tier II protocol and shows the maximum depth that must be sampled for a lake in each trophic state. In oligotrophic lakes, where water is clear, plants may be able to grow in up to 25 feet of water because sunlight may still reach the lake bottom in deep water. In hypereutrophic lakes where water is turbid, lack of sunlight will prevent plants from growing in deep water, so the maximum sampling depth is only 10 feet.

Table 7: Sample depth by Trophic State

Trophic State	Maximum Depth of Sampling (ft)
Hypereutrophic	10
Eutrophic	15
Mesotrophic	20
Oligotrophic	25

Table 8 is used to calculate the number of sample sites need in each depth contour by using lake size and trophic status. The new protocol attempts to more accurately describe the entire littoral zone of a lake and provide more detailed data analysis by separating the littoral zone into 5 foot depth segments.

Table 8: Sample Sites by Lake Size and Trophic State

Tier II Sampling 3

Table 3. Sample size requirements as determined by lake size, trophic state, and apportioned by depth class.

		Hypereutrophic		Eutrophic			Mesotrophic				Oligotrophic				
Lake Acres	Total # of Sites	0-5 foot contour	5-10 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	20-25 foot contour
<10	20	10	10	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	20	10	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	30	10	17	13	10	10	10	10	10	10	10	10	7	3
100-199	50	40	10	23	17	10	14	14	12	10	10	10	10	10	10
200-299	60	50	10	30	20	10	18	16	16	10	14	12	12	12	10
300-399	70	60	10	37	23	10	22	20	18	10	17	15	14	14	10
400-499	80	70	10	43	27	10	25	23	22	10	19	18	17	16	10
500-799	90	80	10	50	30	10	29	27	24	10	22	21	19	18	10
>=800	100	90	10	57	33	10	33	31	26	10	25	23	22	20	10

8.2.1 Tier I Results

The submersed plant community of Lake of the Woods covers roughly 49 acres of the lake, or 11.8% of the lake's total surface area. The dominant plant in the spring survey was sago pondweed, which appears to be increasing throughout the lake. Eurasian watermilfoil was not found, and curly leaf pondweed, another invasive species, was found in moderate abundance in the north end of the lake. Plant growth is very limited in depths of more than 5 feet, which is likely a result of water clarity, planktonic algal blooms, and the whole lake treatment. Most plant beds are found in 1- 4 feet of water and account for most of the diversity in Lake of the Woods.

During the 2006 Tier I surveys, 5 major plant beds were identified. The composition of these plant beds showed little change from spring to fall. The most notable changes were the increases in abundance of sago pondweed, and in curly leaf pondweed abundance in the north end of the lake. Data from the Tier I surveys was used to produce Figure 1. Sago pondweed dominated all of the plant beds except for be #4. Slender naiad, which had been absent in surveys since the Sonar treatment, was found in July of 2006.

Problem Plant Areas:

The largest threat to the plant community in Lake of the Woods is the re-growth of Eurasian watermilfoil. In late September of 2006 some re-growth was observed in the north and northeast sections of the lake (beds #3 and #4). The re-growth consisted only of small fragments found scattered in 1 to 3 acres of water. This is also the same general area where curly leaf pondweed was found in moderate abundance. This area should be closely monitored and could become the major problem plant area in 2007.

Beneficial Plant Areas:

Beneficial native plants are increasing in abundance in all the plant beds in the lake. This is especially evident in beds #2, #3, and #5 on the 2006 submersed plant beds map (Figure 1). Sago pondweed is dominant, and it is hoped that its abundance will continue to increase, along with other natives. Plant bed #5 was one of the most heavily infested areas for Eurasian watermilfoil prior to treatment. In 2006, it was composed mainly of sago pondweed and slender naiad. This is another area where it is hoped that continued growth in native populations will slow or prevent the return of Eurasian watermilfoil.

Figure 1 shows the locations and acreages for the major plant beds in Lake of the Woods.

Figure 1: Lake of the Woods 2006 Major Plant Beds

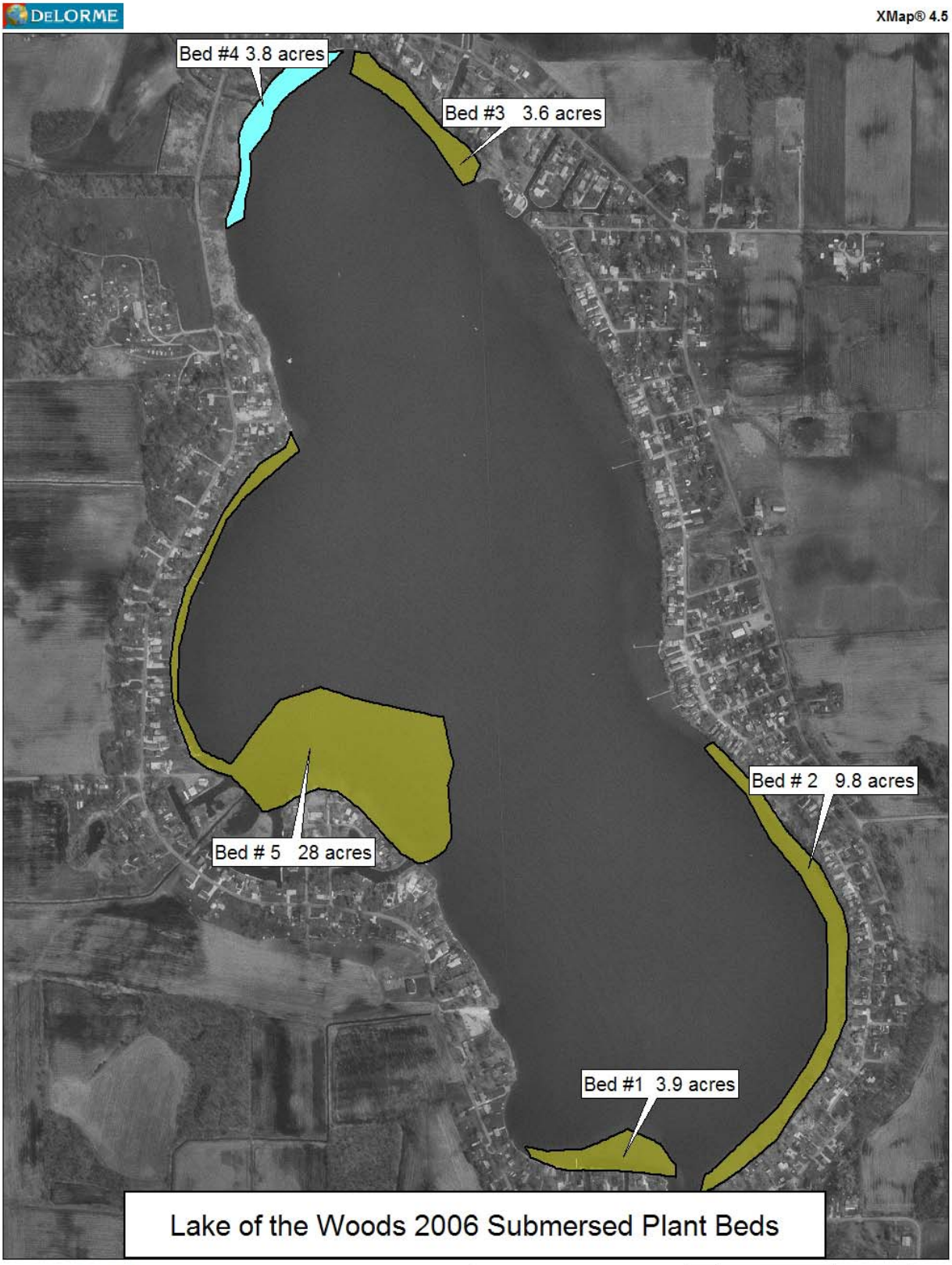


Table 9 shows all of the plant species found in the Tier I surveys and there abundance rating for each plant bed. Blanks indicated that the plant was not present in a particular bed.

Table 9: Tier II Plant Bed Summary

Lake of the Woods 2006 Tier I Submersed Plants

Species Abundance by Plant Bed #

	#1	#2	#3	#4	#5
Plant Species					
Chara	1	2			1
Illinois Pondweed		1			
Sago Pondweed	2		2	1	2
Curly-Leaf Pondweed				2	
Total # of Species	**2**	**2**	**1**	**2**	**2**
Size (Acres)	*3.9*	*9.8*	*3.6*	*3.8*	*28*

Plant Bed #1
Size: 3.9 acres
Substrate: Silt/Sand
Number of Species: 2
Description: Plant bed #1 is located at the extreme south end of the lake and is 3.9 acres. Only 2 plant species were found in this bed during 2006. Sago pondweed was found with an abundance rating of 2 and chara was found very sparingly at less than 2% of the bed.

Plant Bed #2
Size: 9.8 acres
Substrate: Silt/Sand
Number of Species: 2
Description: This plant bed runs along much of the southeast shorleline of the lake. drop-off is fairly abrupt in this area of the lake, so the plant bed extends 50 -100 feet from shore. Chara and Illinois pondweed were both found in this bed. Chara was sparsely distributed and scattered, while Illinois pondweed was found growing in small but thick stands.

Plant Bed #3
Size: 3.6 acres
Substrate: Silt/Sand
Number of Species: 1
Description: This plant bed was located at the north end of the lake and contained only one species. Sago pondweed was found here in 1-4 feet of water. It was found distributed throughout the northeast corner of the lake.

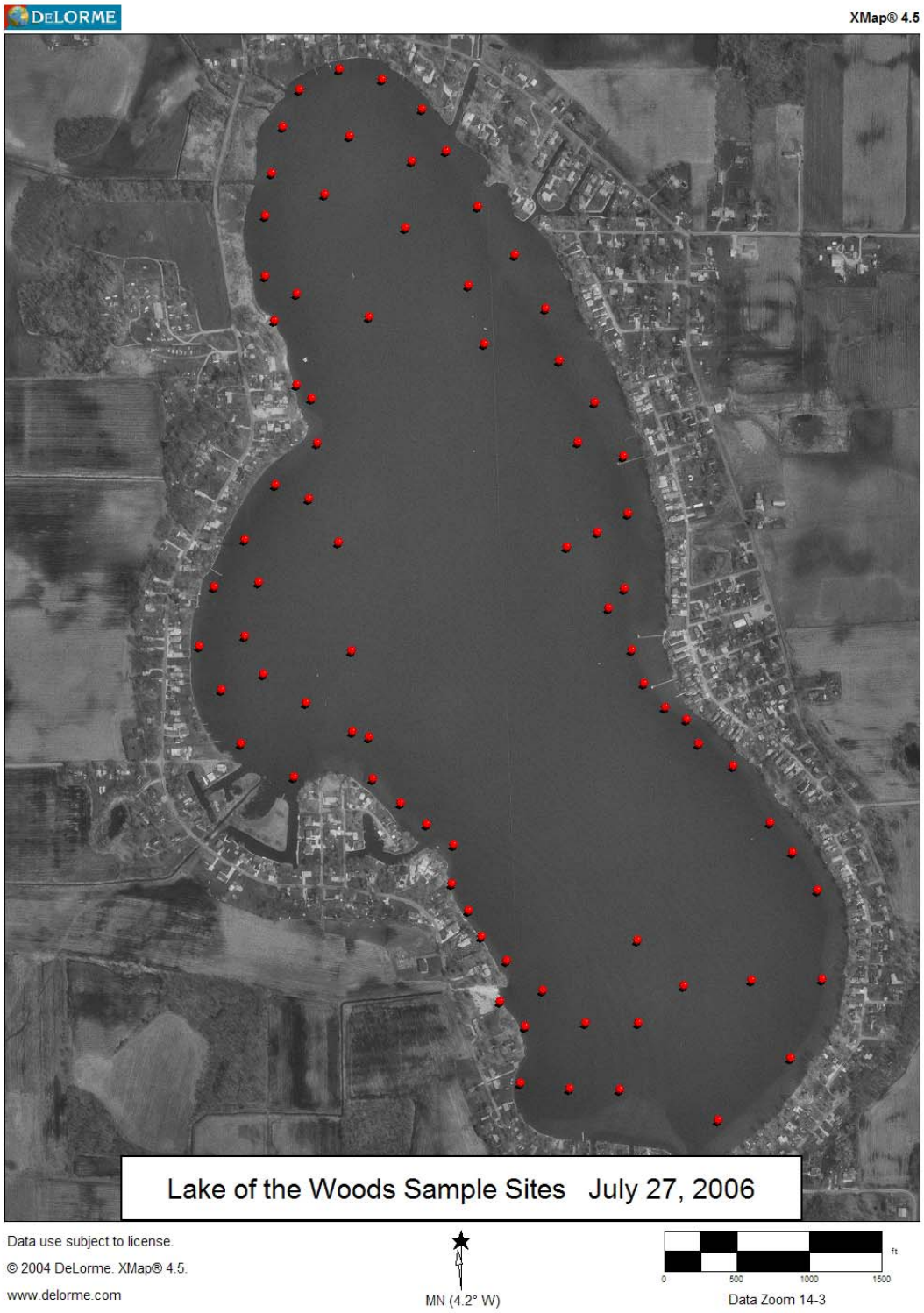
Plant Bed #4
Size: 3.8 acres
Substrate: Silt/Sand
Number of Species: 2
Description: This plant bed, located along the northwest section of the lake, contained 2 plant species. Curly leaf pondweed was more abundant in this bed than in any other area of the lake. It was scattered throughout the bed and was more abundant than sago pondweed in the spring.

Plant Bed #5
Size: 28 acres
Substrate: Sand/Silt
Number of Species: 2
Description: This plant bed covers the large bay along the west side of the lake. Chara and sago pondweed were both found in this bay in the spring, with sago pondweed again being the dominant species. In the July Tier II survey, slender naiad was also found sparingly in this plant bed.

8.2.2 Tier II Results

Historical Secchi depths at Lake of the Woods are between 2.5 and 3.0 feet (Tylia, 2002) feet in the 2006 Tier II survey. Microscopic algae blooms and suspended solids likely contribute to low water clarity, as the lake often displays a green color that is characteristic of some planktonic algae. Eighty rake samples were distributed throughout each 5 foot depth contour of the littoral zone. A total of 4 species of submersed aquatic plants were collected during this survey, with each of the 4 species being native plants. The following map shows the locations of all sample sites during the 2006 Tier II survey. Sample sites differ from 2005, reflecting the change in Tier II protocol for 2006. A greater percentage of samples were collected in deeper water in accordance with 2006 protocol. This change in sample strategy may reduce the amount of vegetation found in the lake, as plants are not common in depth of over five feet.

Figure 2: Lake of the Woods 2006 Tier II Sample Sites



Fall Data Analysis

Tables 10 and 11 are data summaries for the 2006 aquatic vegetation survey. These tables help to describe the plant community, and will help identify any changes that take place in the years to come. Table 10 includes every sample site, and Table 11 describes the 0-5 five foot contour of Lake of the Woods, which was the only contour in which plants were found.

Although samples sites were taken in depths reaching 15 feet of water, no plants were found in water more than five feet deep. For this reason, there is no data analysis for the 5-10 and 10-15 foot depth contours. One consideration for 2007 survey protocol would be to take more rake tosses in depths of less than five feet. This may help to find more vegetation in Lake of the Woods, although it would make year by year data comparison less useful.

Table 10: Fall 2006 Data Analysis – all sites

Occurrence and Abundance of Submersed Aquatic Plants

Date:	7/27/06	Littoral sites with plants:	21	Species diversity:	0.41
Littoral depth (ft):	15.0	Number of species:	4	Native diversity:	0.41
Littoral sites:	80	Maximum species/site:	2	Rake diversity:	0.32
Total sites:	80	Mean number species/site:	0.30	Native rake diversity:	0.32
Secchi:	2.5	Mean native species/site:	0.30	*Mean rake score:	0.51

Common Name	Site frequency	Rel. Freq	Relative density	Mean density	Dominance
Sago Pondweed	22.5	75.0	0.45	2.00	9.0
Richardson's Pondweed	3.8	12.5	0.04	1.00	0.8
Slender Naiad	2.5	8.3	0.03	1.00	0.5
Illinois Pondweed	1.3	4.2	0.04	3.00	0.8

Table 11: Fall 2006 Data Analysis 0-5 foot depth contour

Occurrence and Abundance of Submersed Aquatic Plants

Date:	7/27/06	Littoral sites with plants:	20	Species diversity:	0.37
Littoral depth (ft):	5.0	Number of species:	4	Native diversity:	0.37
Littoral sites:	43	Maximum species/site:	2	Rake diversity:	0.32
Total sites:	43	Mean number species/site:	0.56	Native rake diversity:	0.32
Secchi:	2.5	Mean native species/site:	0.56	*Mean rake score:	0.93

Common Name	Site frequency	Relative density	Mean density	Dominance
Sago Pondweed	41.9	0.84	2.00	16.7
Richardson's Pondweed	7.0	0.07	1.00	1.4
Illinois Pondweed	2.3	0.07	3.00	1.4
Slender Naiad	2.3	0.05	2.00	0.9

No plants were found in the 5-10 foot contour.

The most significant changes observed from the spring survey to the fall survey were the appearance of slender naiad in fall and the absence of curly leaf pondweed. The most significant overall change was the small areas of Eurasian watermilfoil re-growth, although they emerged very late in the growing season, after the surveys had been completed.

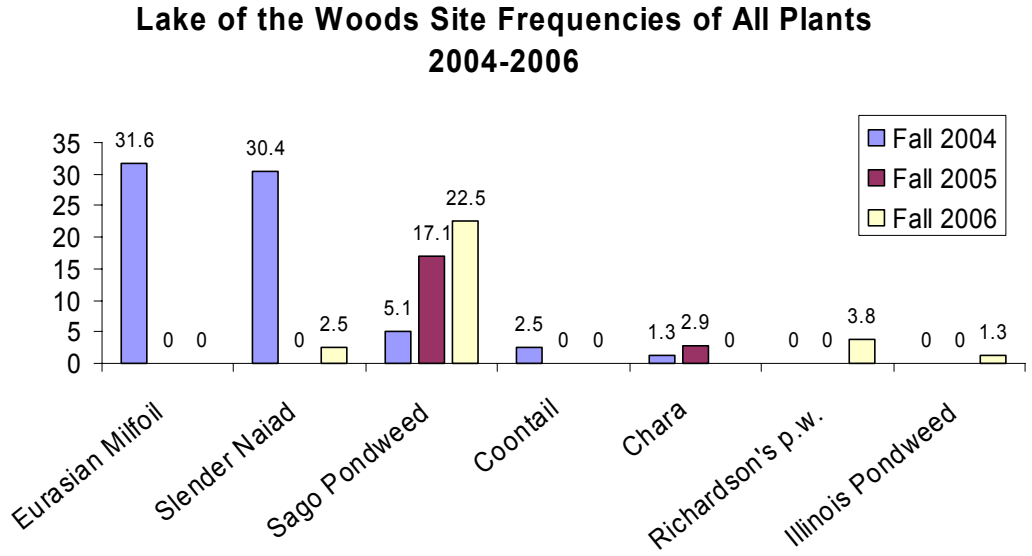
Site Frequency

Site frequency is a measure of how often a species was collected during the Tier II survey. It can be calculated by the following equation:

$$\text{Site Frequency} = \frac{(\text{\# of sites where the species was collected})}{\text{Total \# of littoral sample sites}} \times 100$$

Table 12 shows site frequencies for every plant collected in any of the fall Tier II surveys since the lake was involved in the LARE program. Eurasian watermilfoil was the most frequently collected species in fall of 2004, and has not been collected since the Sonar treatment. Slender naiad was also very common in fall of 2004 and started to come back in fall of 2006. Sago pondweed abundance has steadily increased, probably as a result of reduced competition from Eurasian watermilfoil. Sago pondweed is also known to be resistant to fluridone, which may also account for its increasing abundance.

Table 12: 2004-2006 Sight Frequencies



Mean Density and Relative Density

Mean Density is a measure the abundance of a species in areas where it is growing. For example, a species can have a high site frequency, but still have a very low mean density. This means that a species may be prevalent throughout an entire lake, but it may also be sparsely scattered. Mean density can be calculated using the following equation:

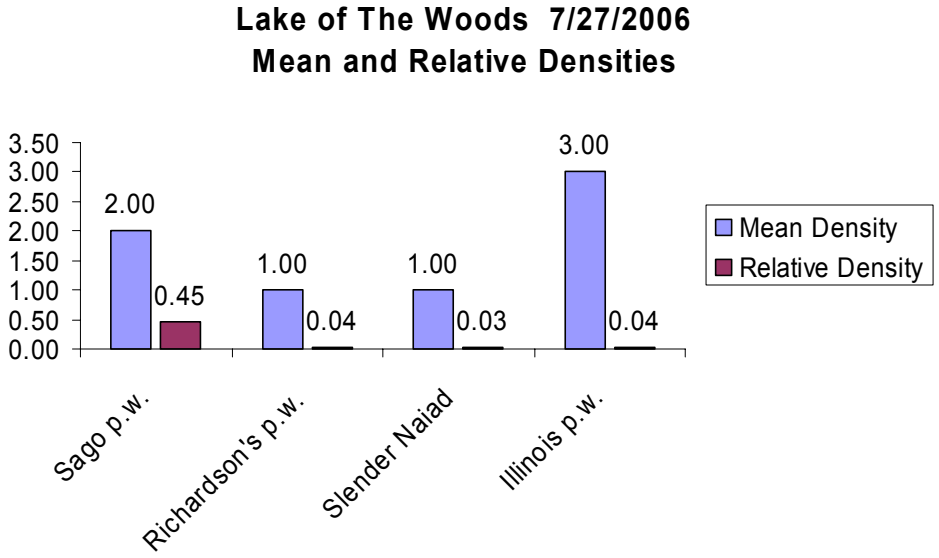
$$\text{Mean Density} = \frac{\text{(The sum of all rake scores for a species)}}{\text{(Total \# of sites where the species was collected)}}$$

Relative Density is calculated much like mean density, only in this case, the sum of the rake scores for a species is divided by the total number of sample sites in the survey. Unless a species was collected at every sample site, the relative density will always be smaller than the mean density.

$$\text{Relative Density} = \frac{\text{(The sum of all rake scores for a species)}}{\text{(Total \# of littoral sample sites)}}$$

Table 13 shows mean and relative densities for each plant found in the fall 2006 Tier II survey. Sago pondweed was second in mean density but highest in relative density, because it was found so frequently. Illinois pondweed had a very high mean density at 3.0 but had a very low relative density (0.04) because it was not frequently collected.

Table 13: Fall 2006 Mean and Relative Densities



Species Diversity

The species diversity indices listed in Tables 10 and 11 help to describe the overall plant community. A species diversity index is actually measured as a value of uncertainty (H). If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that a chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependent upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

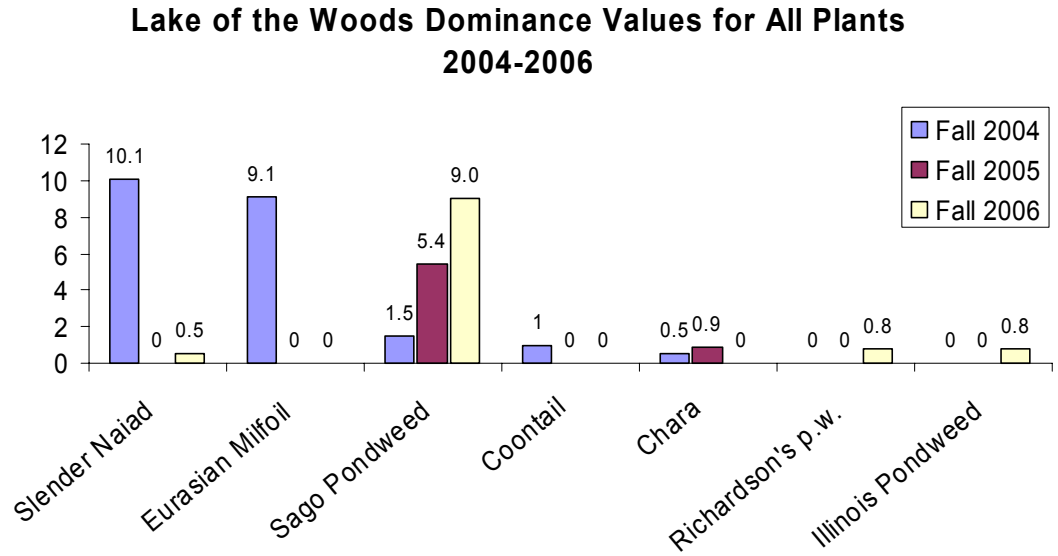
The species diversity index for Lake of the Woods in the fall was 0.41 which is fairly low. Native plant diversity in fall of 2006 was the same as overall diversity at 0.41, which indicates that all species collected in the survey were native plants. Rake diversity and native rake diversity were measured at 0.32 in fall 2006, which is also a very low diversity value.

Species Dominance

Species dominance is dependent upon how many times a species occurs, and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Table 14 tracks dominance values for each plant collected at Lake of the Woods during its involvement in the LARE program. Trends are similar to sight frequency, with Eurasian watermilfoil and slender naiad dominances dropping sharply after the sonar treatment. Slender naiad is very susceptible to fluridone treatments, and its initial population decline was expected. Sago pondweed dominances have increased steadily since the whole lake treatment.

Table 14: 2004-2006 Plant Dominance



Relative Frequency of Occurrence

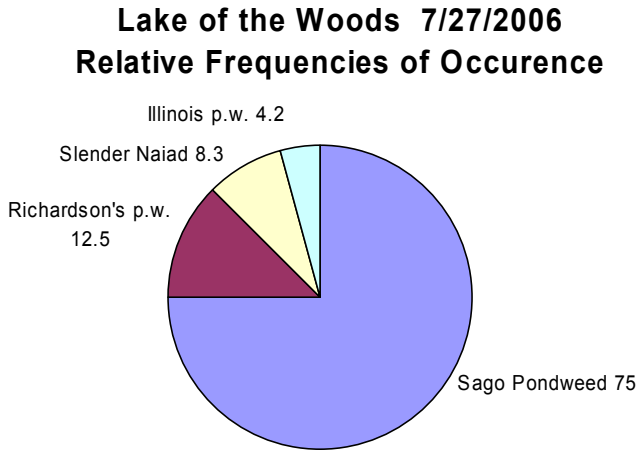
Relative frequency of occurrence is a measure of how often a plant is collected in relation to all of the other plants collected in a Tier II survey. It is demonstrated with the following equation:

$$\text{Relative Freq. of Occurrence} = \frac{\text{The site Frequency for a species} \quad X\ 100}{\text{The sum of all site frequencies including the species in question}}$$

The sum of all relative frequency of occurrence values will always add up to 100. For this reason it is displayed in a pie graph.

Table 15 shows relative frequency of occurrence values for each plant collected in the fall 2006 survey. Sago pondweed had by far the greatest relative frequency of occurrence. Richardson's pondweed had a relative frequency of 12.5, slender naiad was third with a value of 8.3, and Illinois pondweed had a value of 4.2.

Table 15: Fall 2006 Relative Frequencies of Occurrence



8.3 Macrophyte Inventory Discussion

Submersed aquatic vegetation covers an estimated 49 acres, or 11.8% of the total surface area of Lake of the Woods. Of the 49 acres covered with submersed plants, sago pondweed was present throughout, being found in 4 of the 5 plant beds.

Based upon 2006 survey data, Lake of the Woods has a submersed aquatic plant community with relatively low diversity when compared with many area lakes. Species richness in Lake of the Woods was 4 species in the fall of 2006. The plant community is dominated by sago pondweed, which is a beneficial, native plant. Slender naiad is returning to the lake, and Eurasian watermilfoil has just begun to show some re-growth in the lake. As more data is collected in the years to come, long term trends can be identified, and the health and diversity of the plant community can be more closely tracked.

In summary, Lake of the Woods is characterized by a submersed plant community with low diversity (4-6 species), low water clarity (secchi depth 2.5-3.0 ft.) a fairly wide spread distribution of sago pondweed (site frequency 22.5%). Eurasian watermilfoil was just starting to show some re-growth in late September of 2006.

9.0 Aquatic Vegetation Management Alternatives

(See 2004 Lake Management Plan)

Major Eurasian watermilfoil control practices have not changed significantly from the 2004 alternatives.

10.0 Public Involvement

A LARE meeting was held on October 31, 2006 to discuss issues pertaining to Lake of the Woods. District 1 Fisheries staff, lake representatives, Aquatic Weed Control, and LARE Aquatic biologists were all present and discussed the plant community of Lake of the Woods. This meeting helped to develop the 2007 treatment strategy.

A public lake meeting was held for Lake of the Woods on November 4, 2006. Eighteen people were in attendance. Jim Donahoe of Aquatic Weed Control summarized LARE management activities and outlined possible treatments that may be necessary as the Eurasian watermilfoil begins to re-grow in the lake. Residents were very happy with the results of the chemical treatment, as Eurasian watermilfoil was reduced to an undetectable level in summers of 2005 and 2006. They were also glad to see that native plant populations in the lake are rebounding.

Table 16 shows a summary of responses from the public questionnaire handed out at the November 4th meeting.

Table 16: Public Questionnaire Results

Total: 18

Lake Use Survey **Lake name** Lake of the Woods

Are you a lake property owner? **Yes** 17 **No** 0

Are you currently a member of your lake association? **Yes** 17 **No** 0

How many years have you been at the lake?
- 2 or less - 1
- 2 – 5 years - 4
- 5-10 years - 2
- Over 10 years - 11

How do you use the lake (mark all that apply)

17 Swimming	5 Irrigation
18 Boating	1 Drinking water
18 Fishing	1 Other waterskiing
	1 hunting
	1 diving

Do you have aquatic plants at your shoreline in nuisance quantities? **Yes** 5 **No** 12

Do you currently participate in a weed control project on the lake? **Yes** 15 **No** 3

Does aquatic vegetation interfere with your use or enjoyment of the lake? **Yes** 5 **No** 13

Does the level of vegetation in the lake affect your property values? **Yes** 10 **No** 5

Are you in favor of continuing efforts to control vegetation on the lake? **Yes** 18 **No** 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? **Yes** 16 **No** 0

Mark any of these you think are problems on your lake:

1	Too many boats access the lake
3	Use of jet skis on the lake
0	Too much fishing
2	Fish population problem
15	Dredging needed
3	Overuse by nonresidents
0	Too many aquatic plants
2	Not enough aquatic plants
11	Poor water quality
7	Pier/funneling problem

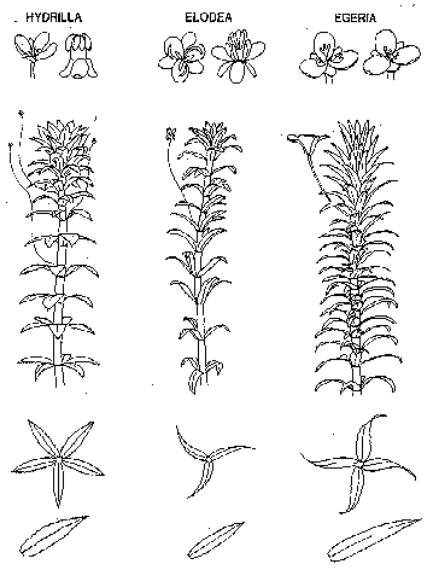
Please add any comments:

By lowering lake 12"; how much damage is done to: aquatic vegetation, water clarity, fish/wildlife, shoreline?; "stop" lowering lake on 9-15 until 5-15, not enough water and limits recreation; please enforce boating laws, prior to treatment, milfoil was very prominent and totally intruding on every aspect of lake. presently the muck causes problems and has always, channel needs dredging behind Abbett Street; Channels need dredged!! Boats/Pontoons hit bottom; I appreciate your efforts to improve water quality on this lake; One lake level needed - change in lake level not healthy; piers need variance for extra long pier due to shallow water; We had terrible problem now dealth with- please continue!

11.0 Public Education

Hydrilla

Hydrilla (*Hydrilla verticillata*) is an invasive aquatic plant species common throughout the southern United States. It is listed as a federally noxious weed and causes severe ecological and recreational problems wherever it grows. It is considered to be much more destructive than other invasives like Eurasian watermilfoil and curly leaf pondweed because of its reproductive adaptations. It grows by fragmentation, as does Eurasian watermilfoil, but it also produces turions which can remain dormant in the sediment for 4 years or more (Van and Steward, 1990). It produces tubers at its root tips which can also reproduce after multiple years of dormancy. It can grow 1 inch each day and it quickly out-competes native plants. It forms dense beds that eliminate native plants, stunt fish populations, impede recreation and cause a drastic decrease in biodiversity (Colle and Shireman, 1980). Millions of dollars are spent each year for hydrilla maintenance each year in Florida alone. Eradication is unlikely once a population has been well established, although eradication has been achieved in newly infested waters using a herbicide called Sonar. Sonar is applied at a rate of 6 parts per billion and this concentration is maintained in the water for 180 days. Early detection can be crucial to an effective eradication program, and all lake residents and users are encouraged to be on the look-out for this invader.



In fall of 2006, this plant was found in Lake Manitou, in Rochester, Indiana. This is the first instance of hydrilla in the upper Midwest. Prior to its appearance in Lake Manitou, The closest infestations of hydrilla were in Tennessee and Pennsylvania.

Hydrilla can easily be confused with native elodea. The major difference is that elodea has sets of leaves on the stem in whorls of three, while hydrilla usually has whorls of 5 leaves, although 4 to 9 leaves per whorl are possible with hydrilla. Hydrilla will also have small serrations on the leaf edges. More information on hydrilla can be found at the University of Florida's Center for Aquatic Invasive Plants (http://plants.ifas.ufl.edu/). More general information on aquatic invaders can be found at www.protectyourwaters.net.

12.0 Integrated Management Action Strategy

Any areas of Eurasian watermilfoil re-growth should be chemically treated in 2007. More re-growth is expected in 2007, as the first signs of any re-growth were seen in September of 2006. However, it is impossible to know the exact acreage that will require treatment in 2007. It is recommended that these areas be treated with Renovate, which is similar in chemistry to 2, 4-D. Renovate has shown the ability to provide 2 years of control in some situations, although it should not be expected. Maintenance of the Eurasian watermilfoil population should be the highest priority. Spot treatments should be limited to areas of Eurasian watermilfoil infestation to protect the native species that are re-colonizing the lake.

If Eurasian watermilfoil forms any dense beds in 2007, the association may also wish to contact District 1 fisheries personnel about restricting boat travel in these areas until it an be treated. This should reduce the potential for milfoil fragments to re-infest other areas of the lake.

The curly leaf pondweed population in Lake of the Woods should also be monitored. Currently it is not at nuisance levels, but it must be watched closely as plants re-colonize the lake. Currently, curly leaf pondweed treatments are a third priority for LARE grant requests behind hydrilla and Eurasian watermilfoil. Curly leaf pondweed often senesces in mid-summer and provides less recreational interference than Hydrilla or Eurasian watermilfoil.

Treatment of native plants along shorelines is not recommended so that natives can continue to increase in the lake.

Aquatic vegetation surveys should also take place in 2007 to continue to monitor the populations of both native and invasive species.

13.0 Project Budget

2007 Management:

2. Chemically treat areas of Eurasian Watermilfoil Regrowth

*All cost figures are estimates only. All prices are subject to change pending 2007 chemical pricing.

A. Treat 20 acres of Eurasian milfoil with Renovate $ 9,500

3. Conduct 2 aquatic vegetation surveys (spring and fall) to monitor both Eurasian milfoil and native plant populations.

A. Spring and Fall Vegetation Survey and Plan Update $ 4,000

Survey and planning costs

Four thousand dollars are currently budgeted for surveying and planning but this cost may be less should LARE reduce the survey intensity and planning required.

14.0 Monitoring and plan Update Procedures

A Tier II vegetation survey should be conducted in spring of 2006, as some areas of Eurasian watermilfoil growth are expected. This survey will indicate any areas that may need spot treatment in 2007. Fall survey intensity may depend upon the results of the spring 2007 survey, and the acreage that may require treatment.

15.0 References

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16.0 Appendices

16.1 Calculations

Fluridone Calculations:

The following paragraph is taken directly from the Sonar A.S. label. It outlines the specific procedures for calculating the amount of Fluridone needed to treat a body of water.

Application Rate Calculation - Ponds, Lakes and Reservoirs

The amount of Sonar A.S. to be applied to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:
Quarts of Sonar A.S. required per treated surface acre = Average water depth of treatment site (feet)
x Desired ppb concentration of active ingredient
x 0.0027
For example, the quarts per acre of Sonar A.S. required to provide a concentration of 25 ppb of active ingredient in water with an average depth of 5 feet is calculated as follows:
5 **x** 25 **x** 0.0027 = 0.33 quarts per treated surface acre
When measuring quantities of Sonar A.S., quarts may be converted to fluid ounces by multiplying quarts to be measured **x** 32. For example, 0.33 quarts **x** 32 = 10.5 fluid ounces.
Note: Calculated rates should not exceed the maximum allowable rate in quarts per treated surface acre for the water depth listed in the application rate table for the site to be treated.

16.2 Common Aquatic Plants of Indiana

The following appendix was compiled using information found in the 5th edition of How to Identify Water Weeds and Algae, edited by James C. Schmidt and James R. Kannenberg. All pictures, with the exception of Illinois pondweed and northern milfoil were taken from the Category 5 Aquatic Pest Control Management Manual, written by Dr. Carole Lembi, Head of the Department of Botany and Plant Pathology at Purdue University.

American Pondweed

Scientific name: *Potamogeton americanus*

Classification: Native to Indiana

Distribution: Common throughout the U.S.

Description: American pondweed can be identified by its oval shaped leaves floating on the top of the water. The base of each leaf tapers to a very long petiole that connects the leaf with the stem of the plant. Plant leaves are arranged alternately on the stem and leaves are usually sparsely scattered.

Chara

Scientific name: *Chara sp*.

Classification: Native to Indiana

Distribution: Extremely common worldwide. Usually found in hard water.

Description: Chara is often mistaken for a vascular plant, but it is actually an advanced form of algae. It can be gray, green or yellow in color and is usually forms extremely dense beds that may cover an entire lake. It can be identified by its distinct musky odor and calcium deposits on the algae's surface make it feel bristly to the touch. It possesses leaf-like structures that are whorled around the hollow stem, and it attaches itself to the lake bottom, although it has no actual roots. It usually grows in shallow, clear water.

Coontail

Scientific name: *Ceratophyllum demersum*

Classification: Native to Indiana

Distribution: Common throughout the U.S., usually in hard water.

Description: Coontail plants are submersed and have no roots, though they appear to be attached to the lake bottom when viewed from above the surface of the water. The free-floating nature of coontail allows it to colonize new areas of a lake quickly, and it often times forms extremely dense weed beds where sufficient light and nutrients are available. Coontail has dark green leaves arranged in whorls around the stem and usually grows in long, bushy strands resembling evergreen trees beneath the surface of the water. Coontail's structure is very similar to Eurasian milfoil but coontail has forked leaves, which distinguishes it from the feather-like projections of milfoil leaves.

Curly Leaf Pondweed

Scientific name: *Potamogeton crispus*

Classification: Exotic to Indiana

Distribution: Found throughout the U.S. in fresh and brackish water.

Description: Curly leaf pondweed usually grows and spreads rapidly in early spring and begins to dies out by midsummer as water temperatures approach 70 degrees Fahrenheit. Curly leaf has extremely thin, membranous leaves arranged alternately on the stem with small teeth-like projections visible along the edge of each leaf. A reproductive spike may be seen protruding from the surface of the water. Curly leaf pondweed may also leave small reproductive structures called turions in the sediment on the lake bottom that can lie dormant throughout the winter and then sprout when spring arrives.

Eel Grass (Wild Celery)

Scientific name: *Vallisneria Americana*

Classification: Native to Indiana

Distribution: Found from the Great Plains to the East Coast of the U.S.

Description: Eel grass has tufts of ribbon-like leaves with a horizontal stem embedded in the sediment connecting each tuft. This native plant grows thick weed beds anchored in the mud by roots. These dense beds often shade out other forms of weeds and provide excellent escape cover for small fish. The flowers of this plant are visible in late summer and sit on the top of a coiled structure protruding to the surface. This plant is found in both lakes and river, but is seldom found in stagnant systems. It is considered an extremely valuable plant to aquatic ecosystems.

Elodea

Scientific Name: *Elodea Canadensis*

Classification: Native to Indiana

Distribution: Common throughout the north and north central united states. Its ranges extends as far south as northern Tennnessee.

Description: Elodea grows in long strands resembling milfoil, but its leaves are broad and oval shaped. Leaves are arranged in whorls with three leaves usually occurring at each node. Leaves near the tip of the plant are closely packed together, with the distance between nodes increasing further down the stem.

Eurasian Milfoil

Scientific Name: *Microphyllum spicatum*

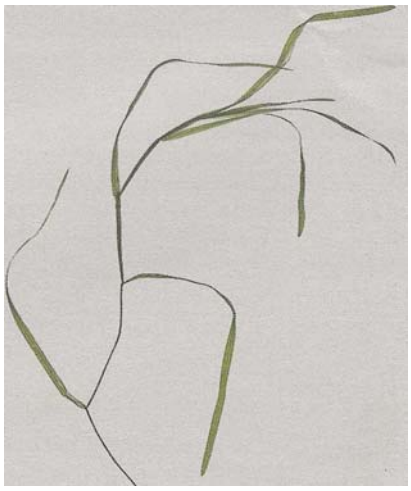
Classification: Exotic in Indiana

Distribution: Common in the Midwest and Eastern U.S. Also spreading along the Pacific coast

Description: This extremely aggressive and extremely destructive plant has leaves in whorls of 4 around a reddish stalk. This plant grows rapidly and can reach lengths of over 10 feet. This plant has the ability to over winter, meaning it can lie dormant during the winter months instead of dying out completely each year. This gives it a distinct advantage over many native species, as it competes for sunlight in early spring. The dormant milfoil plants reach the surface much faster than the native plants sprouting from the lake bottom. This enables the Eurasian milfoil to shade out other plants and form the dense beds that choke the littoral zone of many lakes.

A reproductive process called fragmentation aids the rapid dispersion of Eurasian milfoil. If a milfoil plant is damaged and some fragments are removed from the macrophyte, each small piece of the plant has the ability to grow roots and create a new milfoil plant. Eurasian milfoil is considered one of the most dangerous aquatic nuisance species because of its ability to rapidly disrupt and destroy lake ecosystems.

Flat-stemmed Pondweed



Scientific Name: *Potamogeton zosteriformis*

Classification: Native to Indiana

Distribution: Common throughout the northern half of the U.S.

Description: the most noticeable characteristic is the large, very flat stem. It cannot be rolled between the fingers easily. The ribbon-like leaves extend from the stem toward the surface of the water.

Illinois Pondweed

www.wvu.edu

Scientific name: *Potamogeton illinoensis*

Classification: Native to Indiana

Distribution: Very widespread and very common throughout the upper Midwest and the U.S

Description: Illinois pondweed is common in Indiana, especially in the northern third of the state. This leafy weed has leaves with very broad bases that extend three-fourths of the way around the stem. The upper part of its slender stem is usually branched and very leafy.

Large Leaf Pondweed

Scientific name*:* *Potamogeton amplifolius*
Classification: Native to Indiana
Distribution: Common throughout the upper Midwest and the northern United States in hard water.

Description: This plant has both submersed and floating leaves. The floating leaves are oval shaped and are similar to those of American pondweed. Submersed leaves are arranged alternately with each leaf becoming extremely narrow as it nears the stem of the plant. Mineral deposits on its leaves often give large leaf pondweed a dark brown appearance.

Naiad

Scientific name: *Najas minor* (brittle naiad)

Classification: Native to Indiana

Distribution: Common throughout the U.S.

Description: The leaves of naiad plants are usually widest at the base and gradually become thinner near the tip of the leaf. Plants are extremely leafy and appear bush-like when viewed from above the surface of the water. Many species of naiad are very common in this area. Plant structure often resembles chara, but the absence of calcium deposits on the surface of the plant help in identification. The leaves of brittle naiad have multiple spines along the margins that are visible to the naked eye.

Nitella

Scientific name: *Nitella sp.*

Classification: Native to Indiana

Distribution: Found worldwide, usually in hard water.

Description: Nitella is very similar to chara, and it is also an advanced form of algae. It has leaf-like projections that are whorled around the stem. It is often found growing in very thick patches, usually in shallow, clear water.

Northern Milfoil

www.io.uwinnipeg.ca

Scientific name: *Myriophyllum sibericum*

Classification: Native to Indiana

Distribution: Found throughout the northern half of the U.S. and also in Europe and Western Asia

Description: Northern milfoil has submersed, feather-like, whorled leaves that closely resemble the leaves of Eurasian milfoil. Distinguishing the native northern milfoil from Eurasian milfoil can be difficult. The leaflet pairs of northern milfoil are generally fewer and more widely spaced than those of Erasian milfoil. This plant is known to hybridize with Eurasian milfoil, and at times, chemical analysis is necessary to distinguish between the two plants.

Sago Pondweed

Scientific name: *Potemogeton pectinatus*

Classification: Native to Indiana

Distribution: Found throughout the U.S., Common in the northern 2/3 of Indiana.

Description: Sago Pondweed has a bushy appearance with narrow, thread-like leaves that spread out to resemble a fan. Leaves are usually 1/16 of an inch wide and 1 to 6 inches long. Nutlets are formed on a string-like structure and protrude from the surface of the water. While sago pondweed can form dense beds, many times it is found in sparse, loosely distributed arrangements.

16.3 Pesticide Use Restrictions Summary:

The following table was produced by Purdue University and included in the Professional Aquatic Applicators Training Manual. It gives a summary of water use restrictions on all major chemicals available for use in the aquatics market.

Table 17: Pesticide Use Restrictions

Table 1. Aquatic Herbicides and Their Use Restrictions. Always check the label because these restrictions are subject to change.

	Human			Animal	Irrigation		
	Drinking	Swimming	Fish Consumption	Drinking	Turf	Forage	Food Crops
	waiting period, in days						
Copper Chelate	0	0[a]	0	0	0	0	0
Copper Sulfate	0	0[a]	0	0	0	0	0
Diquat	1–3	0[a]	0	1	1–3	1–3	5
Endothall (granular)[b]	7	0[a]	3	0	7	7	7
Endothall (liquid)[b]	7–25	0[a]	3	7–25	7–25[d]	7–25	7–25
Endothall 191 (granular)[c]	7–25	0[a]	3	7–25	7–25	7–25	7–25
Endothall 191 (liquid)[c]	7–25	0[a]	3	7–25	7–25	7–25	7–25
Fluridone	0[e]	0[a]	0	0	7–30	7–30	7–30
Glyphosate	0[e]	0[a]	0	0	0	0	0
2,4-D (granular)	*	0[a]	0	*	*	*	*

[a]Although this compound has no waiting period for swimming, it is always advisable to wait 24 hours before permitting swimming in the direct area of treatment.

[b]Trade name is Aquathol®.

[c]Trade name is Hydrothol®.

[d]May be used for sprinkling bent grass immediately.

[e]Do not apply this product within 1/4 (fluridone) to 1/2 (glyphosate) mile upstream of potable water intakes.

*Do not use treated water for domestic purposes, livestock watering (2,4-D, dairy animals only), or irrigation.

16.4 Resources for Aquatic Management

In addition to the LARE Program, there are many other sources of potential funding to help improve the quality of Indiana Lakes. Many government agencies assist in projects designed to improve environmental quality.

The USDA has many programs to assist environmental improvement. More information on the following programs can be found at www.usda.gov.

Watershed Protection and Flood Prevention Program (USDA

Conservation Reserve Program (USDA)

Wetlands Reserve Program (USDA)

Grassland Reserve Program (USDA)

Wildlife Habitat Incentive Program (USDA)

Small Watershed Rehabilitation Program (USDA)

The following programs are offered by the U.S. Fish and Wildlife Service. More information about the Fish and Wildlife service can be found at www.fws.gov

Partners for Fish and Wildlife Program (U.S. Fish and Wildlife Service)

Bring Back the Natives Program (U.S. Fish and Wildlife Service)

Native Plant Conservation Program (U.S. Fish and Wildlife Service)

The Environmental Protection Agency, the Indiana Department of Environmental Management, and the U.S. Forest Service also have numerous programs for funding. A few of these are listed below. More information can be found at www.in.gov/idem and www.fs.fed.us/

U.S. Environmental Protection Agency Environmental Education Program (EPA)

NPDES Related State Program Grants (IDEM)

Community Forestry Grant Program (U.S. Forest Service)

16.5 State Regulations for Aquatic Plant Management

The following information is found on the IDNR website and outlines general regulations for the management of aquatic plants in public waters.

AQUATIC PLANT CONTROL PERMIT REGULATIONS
Indiana Department of Natural Resources

Note: In addition to a permit from IDNR, public water supplies cannot be treated without prior written approval from the IDEM Drinking Water Section. **Amended state statute adds biological and mechanical control (use of weed harvesters) to the permit requirements, reduces the area allowed for treatment without a permit to 625 sq ft, and updates the reference to IDEM.** *These changes become effective on July 1, 2002.*

Chapter 9. Regulation of Fishing
IC 14-22-9-10

Sec. 10. (a) This section does not apply to the following:
(1) A privately owned lake, farm pond, or public or private drainage ditch.
(2) A landowner or tenant adjacent to public waters or boundary waters of the state, who chemically, mechanically, or physically controls aquatic vegetation in the immediate vicinity of a boat landing or bathing beach on or adjacent to the real property of the landowner or tenant if the following conditions exist:
(A) The area where vegetation is to be controlled does not exceed:
(i) twenty-five (25) feet along the legally established, average, or normal shoreline;
(ii) a water depth of six (6) feet; and
(iii) a total surface area of six hundred twenty-five (625) square feet.
(B) Control of vegetation does not occur in a public waterway of the state.
(b) A person may not chemically, mechanically, physically, or biologically control aquatic vegetation in the public waters or boundary waters of the state without a permit issued by the department. All procedures to control aquatic vegetation under this section shall be conducted in accordance with rules adopted by the department under IC 4-22-2.
(c) Upon receipt of an application for a permit to control aquatic vegetation and the payment of a fee of five dollars ($5), the department may issue a permit to the applicant. However, if the aquatic vegetation proposed to be controlled is present in a public water supply, the department may not, without prior written approval from the department of environmental management, approve a permit for control of the aquatic vegetation.
(d) This section does not do any of the following:
(1) Act as a bar to a suit or cause of action by a person or governmental agency.
(2) Relieve the permittee from liability, rules, restrictions, or permits that may be required of the permittee by any other governmental agency.
(3) Affect water pollution control laws (as defined in IC 13-11-2-261) and the rules adopted under water pollution control laws (as defined in IC 13-11-2-261).
As added by P.L.1-1995, SEC.15. Amended by P.L.1-1996, SEC.64.

312 IAC 9-10-3 Aquatic vegetation control permits
Authority: IC 14-22-2-6; IC 14-22-9-10
Affected: IC 14-22-9-10

Sec. 3. (a) Except as provided under IC 14-22-9-10(a), a person shall obtain a permit under this section before applying a substance to waters of this state to seek aquatic vegetation control.
(b) An application for an aquatic vegetation control permit shall be made on a departmental form and must include the following information:
(1) The common name of the plants to be controlled.
(2) The acreage to be treated.
(3) The maximum depth of the water where plants are to be treated.
(4) The name and amount of the chemical to be used.
(c) A permit issued under this section is limited to the terms of the application and to conditions imposed on the permit by the department.

(d) Five (5) days before the application of a substance permitted under this section, the permit holder must post clearly, visible signs at the treatment area indicating the substance that will be applied and what precautions should be taken.

(e) A permit issued under this section is void if the waters to be treated are supplied to the public by a private company or governmental agency. *(Natural Resources Commission; 312*

16.6 Public Input Questionnaire

Table 18: 2006 Public Questionnaire

Total: 18

Lake Use Survey — Lake name Lake of the Woods

Are you a lake property owner? Yes 17 No 0

Are you currently a member of your lake association? Yes 17 No 0

How many years have you been at the lake?
- 2 or less - 1
- 2 – 5 years - 4
- 5-10 years - 2
- Over 10 years - 11

How do you use the lake (mark all that apply)
- 17 Swimming
- 18 Boating
- 18 Fishing
- 5 Irrigation
- 1 Drinking water
- 1 Other waterskiing
  - 1 hunting
  - 1 diving

Do you have aquatic plants at your shoreline in nuisance quantities? Yes 5 No 12

Do you currently participate in a weed control project on the lake? Yes 15 No 3

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes 5 No 13

Does the level of vegetation in the lake affect your property values? Yes 10 No 5

Are you in favor of continuing efforts to control vegetation on the lake? Yes 18 No 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes 16 No 0

Mark any of these you think are problems on your lake:
- 1 Too many boats access the lake
- 3 Use of jet skis on the lake
- 0 Too much fishing
- 2 Fish population problem
- 15 Dredging needed
- 3 Overuse by nonresidents
- 0 Too many aquatic plants
- 2 Not enough aquatic plants
- 11 Poor water quality
- 7 Pier/funneling problem

Please add any comments:
By lowering lake 12"; how much damage is done to: aquatic vegetation, water clarity, fish/wildlife, shoreline?; "stop" lowering lake on 9-15 until 5-15, not enough water and limits recreation; please enforce boating laws, prior to treatment, milfoil was very prominent and totally intruding on every aspect of lake. presently the muck causes problems and has always, channel needs dredging behind Abbett Street; Channels need dredged!! Boats/Pontoons hit bottom; ☺ appreciate your efforts to improve water quality on this lake; One lake level needed - change in lake level not healthy; piers need variance for extra long pier due to shallow water; We had terrible problem now dealth with - please continue!

16.7 Species Distribution Maps

Figure 3: 2006 Slender Naiad Sites

Figure 4: 2006 Sago Pondweed Sites

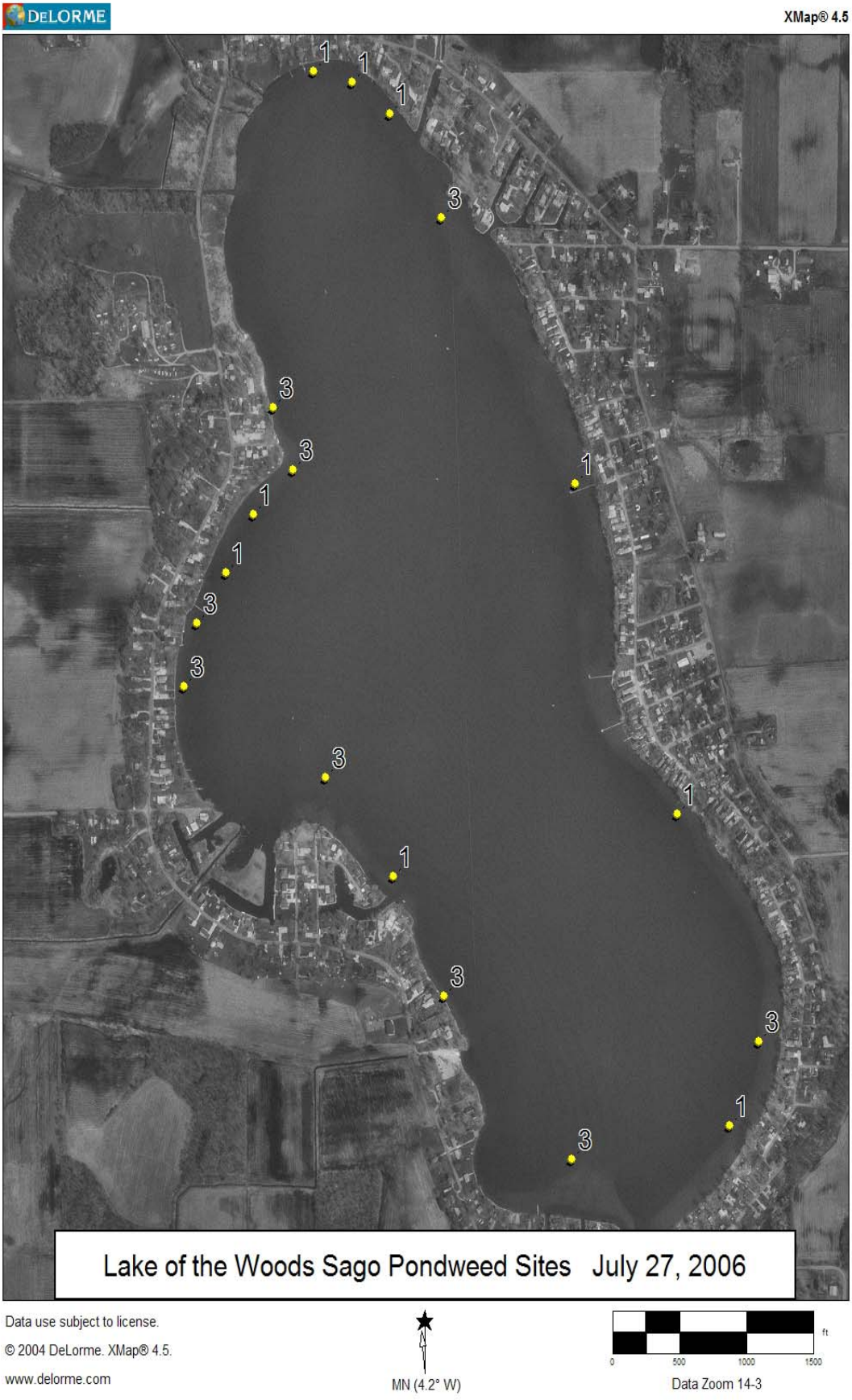


Figure 5: 2006 Richardson's Pondweed Sites

Figure 6: 2006 Illinois Pondweed Sites

16.8 Data sheets

APPENDIX A

Submersed Aquatic Plant Survey Form

Page 1 of 3

WATER BODY NAME	Lake of the Woods				SECCHI	2.5 ft									
COUNTY	Marshall				MAX PLANT DEPTH	15 (5)									
DATE	July 27, 2006				WEATHER	Cloudy / Rain / upper 80's / calm									
CREW LEADER	Dave				COMMENTS										
RECORDER	Dave														
					Rake score (1-5), observed only (9), algae present (p)										
					Use acronyms for species, V1, V2...for voucher codes										Note
					Species Code										
Site	Northing	Easting	Depth	All	POPEL	PORIZ	VAFL								
1	GPS Way Points		3	0											
2	↓	↓	3	0											
3			2	3	3										
4			4	0											
5			2	1	1										
6			2	3	3	1									
7			4	1		1									
8			3	0											
9			5	1	1										
10			2	0											
11			4	0											
12			2	0											
13			5	0											
14			2	1	1										
15			2	1		1									
16			5	0											
17			4	0											
18			2	0											
19			2	3	3										
20			4	0											
21			3	1	1										
22			3	1	1										
23			2	1	1										
24			3	0											
25			4	0											
26			3	0											
27			4	0											
28			5	0											
29			3	0											
30			2	3	3										
31			2	3	3										
32			2	1	1		1								
Other plant species observed at lake															

APPENDIX A

Submersed Aquatic Plant Survey Form

Page 2 of 3

WATER BODY NAME	LotW	SECCHI	2.5
COUNTY	Marshall	MAX PLANT DEPTH	15 (5)
DATE	July 27, 2006	WEATHER	cloudy/rainy/calm/upper 80's
CREW LEADER	Dave	COMMENTS	
RECORDER	Dave		

Rake score (1-5), observed only (9), algae present (p)

Use acronyms for species, V1, V2...for voucher codes

Site	Northing	Easting	Depth	All	POPEG	POAM	NAFL	POIL	Note
					Species Code				
33			4	1	1				
34			2	3	3				
35			2	3	3				
36			5	0					
37			5	0					
38			4	0					
39			3	3	3		1		
40			1	0					
41			2	3	1			3	
42			3	0					
43			3	3	3				
44			9	0					
45			8	0					
46			6	0					
47			7	0					
48			10	0					
49			9	0					
50			10	0					
51			7	0					
52			10	0					
53			9	0					
54			7	0					
55			8	0					
56			8	0					
57			7	0					
58			8	0					
59			10	0					
60			9	0					
61			8	0					
62			10	0					
63			9	0					
64			10	0					

Other plant species observed at lake

APPENDIX A

Submersed Aquatic Plant Survey Form

Page 3 of 3

WATER BODY NAME	Lake of the Woods				SECCHI	2.5										
COUNTY	Marshall				MAX PLANT DEPTH	15 (5)										
DATE	July 27, 2006				WEATHER	Cloudy / Rainy / calm / upper 80's										
CREW LEADER	Dave				COMMENTS											
RECORDER	Dave															
					Rake score (1-5), observed only (9), algae present (p)											
					Use acronyms for species, V1, V2...for voucher codes											Note
					Species Code											
Site	Northing	Easting	Depth	All												
65			7	0												
66			8	0												
67			9	0												
68			6	6												
69			8	0												
70			7	0												
71			15	0												
72			14	0												
73			12	0												
74			11	0												
75			14	0												
76			11	0												
77			13	0												
78			15	0												
79			15	0												
80			15	0												
Other plant species observed at lake																

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Lake of the Woods

DATE: 5/18/06

SITE INFORMATION

Plant Bed ID: 51

Waterbody Name: Lake of the Woods

Bed Size: 3.9 acres

Substrate: 3

Waterbody ID:

Marl? 0

Total # of Species 2

High Organic? 1

Canopy Abundance at Site

S: 4 N: – F: – E: –

SITE COORDINATES

Center of the Bed

Latitude: N41 25.066

Longitude: W86 13.482

Max. Lakeward Extent of Bed

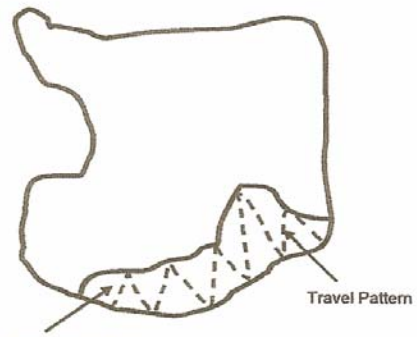
Latitude: N41 24.895

Longitude: W86 13.531

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POPEG	2			
CHARA	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Lake of the Woods

DATE: 5/18/06

SITE INFORMATION

Plant Bed ID: S 2

Waterbody Name: Lake of the Woods

Bed Size: 9.8 acres

Substrate: 3

Waterbody ID:

Marl? 0

Total # of Species

High Organic? 1

Canopy Abundance at Site

S: 4 N: – F: – E: –

SITE COORDINATES

Center of the Bed

Latitude: N41 25.103

Longitude: W86 13.220

Max. Lakeward Extent of Bed

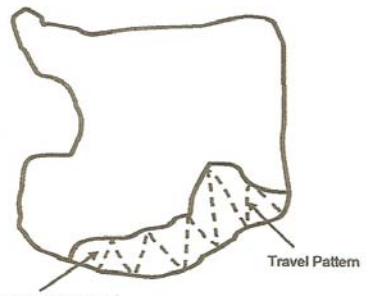
Latitude: N41 25.097

Longitude: W86 13.236

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POPE6	2			
POIL	1			

Individual Plant Bed Survey



Comments: 5 Parcels scattered sago. also found Illinois PW

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species susp
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Lake of the Woods

DATE: 5/18/06

SITE INFORMATION

Plant Bed ID: 53

Waterbody Name: Lake of the Woods

Bed Size: 3.6 acres

Substrate: 3

Waterbody ID:

Marl? 0

Total # of Species 1

High Organic? 1

Canopy Abundance at Site

S: 4 N: - F: - E: -

SITE COORDINATES

Center of the Bed

Latitude: N41 26.013

Longitude: W86 13.830

Max. Lakeward Extent of Bed

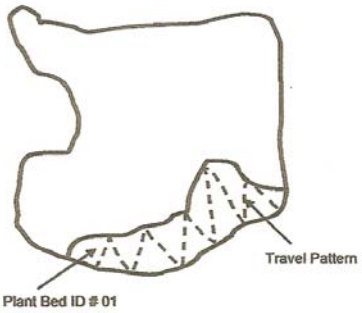
Latitude: N41 26.013

Longitude: W86 13.846

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POPE6	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species susp
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Lake of the Woods

DATE: 5/18/06

SITE INFORMATION

Plant Bed ID: S 4

Waterbody Name: Lake of the Woods

Bed Size: 3.8 acres

Substrate: 3

Waterbody ID:

Marl? 0

Total # of Species 2

High Organic? 1

Canopy Abundance at Site

S: 4 N: – F: – E:

SITE COORDINATES

Center of the Bed

Latitude: N41 26.035

Longitude: W86 14.049

Max. Lakeward Extent of Bed

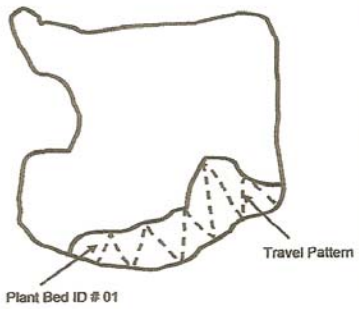
Latitude: N41 26.022

Longitude: W86 14.038

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POCR3	2			
POPE6	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 5

State of Indiana Department of Natural Resources

ORGANIZATION: Lake of the Woods

DATE: 5/18/06

SITE INFORMATION

Plant Bed ID: 55

Waterbody Name: Lake of the Woods

Bed Size: 2 Acres

Substrate: 3

Waterbody ID:

Marl? 0

Total # of Species 2

High Organic? 1

Canopy Abundance at Site

S: 4 N: - F: - E: -

SITE COORDINATES

Center of the Bed

Latitude: N41 25.308

Longitude: W86 14.044

Max. Lakeward Extent of Bed

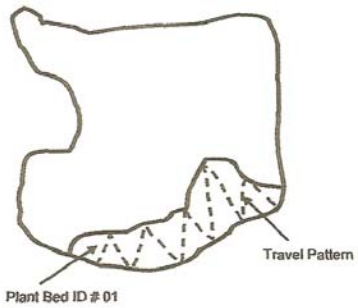
Latitude: N41 25.382

Longitude: W86 13.980

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POPFG	2			
CHTAR	1			

Individual Plant Bed Survey



Comments:

sparsely scattered Sago

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifier

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

16.9 IDNR Aquatic Vegetation Permit

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT

State Form 26727 (R4 / 2-04)
Approved State Board of Accounts 2004

☐ Whole Lake ☐ Multiple Treatment Areas
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY
License No.
Date Issued
Lake County

Return to: Page 1 of ___
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE: $5.00

Applicant's Name	Lake Assoc. Name	
Lake of The Woods Property Owners Association	Lake of The Woods Property Owners Association	
Rural Route or Street: 3119 Sea Lane		Phone Number: 574-546-4100
City and State: Bremen IN		ZIP Code: 46506
Certified Applicator (if applicable)	Company or Inc. Name	Certification Number
Rural Route or Street		Phone Number
City and State		ZIP Code

Lake (One application per lake)	Nearest Town	County
Lake of The Woods	Bremen	Marshall
Does water flow into a water supply		☐ Yes ☒ No

Please complete one section for *EACH* treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area #	LAT/LONG or UTM's	
Total acres to be controlled: 20	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft): 5	Expected date(s) of treatment(s): May / August	

Treatment method: ☒ Chemical ☐ Physical ☐ Biological Control ☐ Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Renovate / 2-4,D

Plant survey method: ☒ Rake ☐ Visual ☐ Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Area's to be treated based on spring / Fall Survey		

Aquatic Weed Control

Page ____ of

Treatment Area #	LAT/LONG or UTM's	
Total acres to be controlled	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	Expected date(s) of treatment(s)	

Treatment method: ☐ Chemical ☐ Physical ☐ Biological Control ☐ Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. _____

Plant survey method: ☐ Rake ☐ Visual ☐ Other (specify) _____

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community

INSTRUCTIONS: Applicant must sign the application and is the only signature required. If applicant is also a certified chemical applicator, sign the "certified applicator" signature box

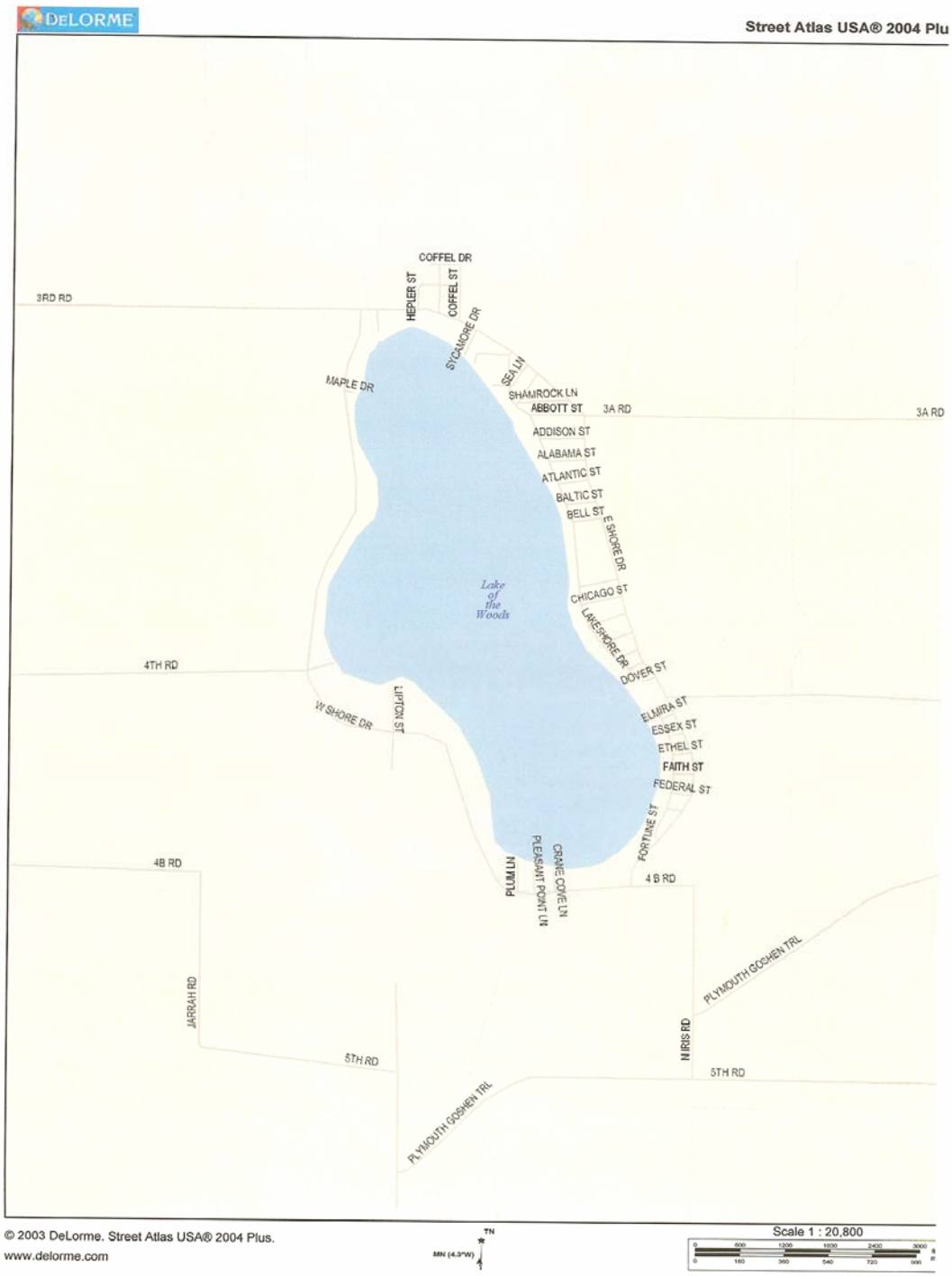
Applicant Signature	Date
Certified Applicator's Signature	Date

FOR OFFICE ONLY

☐ Approved ☐ Disapproved	Fisheries Staff Specialist
☐ Approved ☐ Disapproved	Environmental Staff Specialist

Mail check or money order in the amount of $5.00 to:

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
COMMERCIAL LICENSE CLERK
402 WEST WASHINGTON STREET ROOM W273
INDIANAPOLIS, IN 46204


DeLORME
Street Atlas USA® 2004 Plu
COFFEL DR
HEPLER ST
COFFEL ST
3RD RD
SYCAMORE DR
SEA LN
MAPLE DR
SHAMROCK LN
ABBOTT ST
3A RD
3A RD
ADDISON ST
ALABAMA ST
ATLANTIC ST
BALTIC ST
BELL ST
E SHORE DR
Lake of the Woods
CHICAGO ST
LAKESHORE DR
4TH RD
DOVER ST
W SHORE DR
LIPTON ST
ELMIRA ST
ESSEX ST
ETHEL ST
FAITH ST
FEDERAL ST
FORTUNE ST
4B RD
PLUM LN
PLEASANT POINT LN
CRANE COVE LN
4 B RD
PLYMOUTH GOSHEN TRL
JARRAH RD
N IRIS RD
5TH RD
5TH RD
PLYMOUTH GOSHEN TRL
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TN
MN (4.3°W)
Scale 1 : 20,800